NUI Galway
OÉ Gaillimh

Semester II Examinations 2021-2022

Course Instance Code(s)	4BCT1, 4BS2
Exam(s)	4th B.Sc. Computer Science and IT B.Sc. (Hons)
Module Code(s)	CT421
Module(s)	Artificial Intelligence
Paper No.	1
External Examiner(s)	Dr. R. Trestion
Internal Examiner(s)	Professor M. Madden *Dr. C. O'Riordan

Instructions: Answer any three questions. All questions carry equal marks

Duration	2 hours
No. of Pages	3
Discipline(s)	Computer Science
Course Co-ordinator(s)	Dr. C. O'Riordan

Requirements:
Release in Exam Venue Yes [Y] No [ ]

PTO

CT421 Artificial Intelligence

Q.1.

(a) With respect to uninformed search of trees, describe the iterative deepening approach and discuss the efficiency of the approach in terms of time and memory. (7)

(b) In adversarial search the *minimax algorithm* and *alpha-beta* pruning are often employed. Using a suitable example, explain in your words these two approaches (8)

(c) The minimax algorithm is often applied in two player games when one can list all game states. Discuss, briefly, how you might extend the approach to deal with:

a) A three player game
b) Scenarios when you cannot enumerate all potential game states

(10)

Q.2.

(a) With reference to the schema theorem, explain the effects on a population of solutions of:

a) Mutation
b) Crossover
c) Selection (11)

(b) The multiple knapsack problem can be stated as follows:

There exist N items each with a corresponding value and weight. The goal is to place a subset of these items into a set of knapsacks such that the value of the items placed in the knapsack is maximised. Each knapsack as a capacity (maximum weight). You cannot place items into a knapsack greater than the capacity of the knapsack.

Each instantiation of the problem is a list of items (with value and weight) and a list of knapsacks with their maximum capacity.

i) Describe a suitable fitness function
ii) Describe a suitable representation of the chromosomes in your population
iii) Discuss how you might implement mutation
iv) Discuss how you might implement crossover.

(14)

Q.3.

(a) Auction protocols have been adopted in the multi-agent system community as a means to allow agents find an agreement suitable to all parties. Compare the English auction protocol with the Dutch auction protocol. Your answer should include:

i) A description of the protocol involved
ii) An explanation of the rational strategy for the bidders
iii) Any potential limitations of the protocol.

(9)

(b) Auctions have been used to allow a set of agents agree on a price. Often, agents need to agree on more than one attribute. Suggest an efficient approach that would allow agents to find points of agreement for items or tasks that can be characterised by a number of different attributes. (8)

(c) Game theory has been used in a number of domains to model and reason about strategic decision making. Using the prisoner's dilemma as an example, discuss the advantages and limitations of game theory. (8)

Q.4.

(a) Artificial Life attempts to explore aspects of living systems. Choosing any suitable examples:

i) Describe an example that shows the emergence of complex behaviours given simple rules of interaction
ii) Give an example where properties of a naturally occurring system has been used to inform the design of useful algorithms

(8)

(b) Describe, in your own words, what is meant by neuro-evolution. Your answer should include a description of representations possible and the advantages and limitations of the approach. (9)

(c) Explain briefly the importance of *explainability* in artificial intelligence. With reference to an AI paradigm of your choice, outline approaches that have been taken towards providing AI systems with explanations. (8)